OFFICE OF ENVIRONMENTAL MANAGEMENT

	FY 1995
Office of Environmental Management - Grand Total	$30,489,600
Office of Waste Management	$ 7,563,600
High Level Waste Division	$ 7,563,000
Materials Preparation, Synthesis, Deposition, Growth or Forming	$ 5,667,000
Technical Support to West Valley Demonstration Project	1,300,000
Ceramic Final Forms	300,000
Microencapsulation in Final Forms	67,000
Final Waste Form Program	4,000,000
Materials Properties, Behavior, Characterization or Testing	$ 1,896,600
Materials Characterization Center Testing of West Valley Formulation Glass	396,600
Argonne National Laboratory High-Level Waste Borosilicate Glass Testing Program	1,500,000
Office of Science and Technology	$22,926,000
Materials Preparation, Synthesis, Deposition, Growth or Forming	$16,070,000
Polymer Encapsulation	1,764,000
Microwave Solidification	1,300,000
Fixed Hearth Plasma Treatment Process	3,455,000
Fixed Hearth Plasma Radioactive Waste Test	2,623,000
Phosphate-Bonded Ceramic Waste Forms	(carryover funding)
High Temperature Demonstrations on Actual Mixed Waste	909,000
Plasma Testing & Support	2,160,000
Stainless Steel Beneficial Reuse	1,931,000
Recycle of Depleted Uranium Studies	400,000
Demonstrate Contaminated Metal Recycle Integration and Optimization	649,000
Metal Recycle Technology Development	299,000
Surface Acoustic Wave Array Detectors	230,000
Versatile, Robust, Miniature Sized and Real-Time Radiation Detector	350,000
Materials Properties, Behavior, Characterization or Testing	$ 6,856,000
Vitrify to Delist to Dispose	736,000
Vitrification of Rocky Flats Waste	309,000
Plasma Hearth Process Radioactive Waste Test - Idaho	1,350,000
Vitreous Ceramic Compositional Envelope Study	200,000
Graphite DC Plasma Arc Melter	1,242,000
Vitreous Ceramic Formulation	200,000
Hot Cell Studies	400,000
Cesium Removal Demonstration	700,000
Tc and Ni Removal Ion Exchange	546,000
Crystalline Silicotitanate for Cs/Sr Removal	873,000
TUCS/Phosphate Immobilization of Actinides	300,000

OFFICE OF ENVIRONMENTAL MANAGEMENT

The Office of Environmental Management (EM) was established to effectively coordinate and manage the Department's activities to remediate the DOE Defense Complex and to properly manage waste generated by current operations. EM conducts materials research within four Offices:

Office of Waste Management - The Office of Waste Management uses current technologies to minimize production of DOE-generated waste, alter current processes to reduce waste generation, and work with the technology developers to develop innovative technologies for the treatment and disposal of present and future waste streams. The mission of the Office is to minimize, treat, store, and dispose of DOE waste to protect human health, safety, and the environment.

Office of Environmental Restoration - The Office of Environmental Restoration directs the cleanup of inactive facilities and sites contaminated by waste generated from past nuclear operations. The mission of the Office is to ensure that risks to the environment and to human health and safety posed by inactive and surplus facilities and sites are either eliminated or reduced to prescribed, acceptable levels.

Office of Science and Technology - The Office of Science and Technology is responsible for managing the national program of environmental applied research and technology development. The Office manages and directs research, development, demonstration, testing, and evaluation programs and activities that are designed to provide complete innovative technologies and technology systems to address the major problems facing the Office of Environmental Management.

Office of Nuclear Materials and Facility Stabilization - One of the Office of Environmental Management's (EM) goals is to ensure that the risks to human health and safety and to the environment posed by inactive and surplus facilities are either eliminated or reduced to prescribed, acceptable levels. The Office of Facility Transition and Management was established within EM to develop and institutionalize a Departmental process for the timely and effective transfer of surplus facilities and to implement that process in transitioning surplus facilities to EM for final disposition.

Five Focus Areas have been formed to focus the EM-wide technology development activities on DOE's most pressing environmental management problems and are co-led by all EM offices:

Contaminant Plume Containment and Remediation - Uncontained hazardous and radioactive contaminants in soil and ground water exist throughout the DOE Complex. There is insufficient information at most sites on the contaminants' distribution and concentration. The migration of some contaminants threatens water resources and, in some cases, has already had an adverse impact on the off-site environment. Many current characterization, containment, and treatment technologies are ineffective or too costly. Improvements are needed in characterization and data interpretation methods, containment systems, and in situ treatment.

Landfill Stabilization - Numerous DOE landfills pose significant remediation challenges. Some existing landfills have contaminants that are migrating, thus requiring interim containment prior to final remediation. Materials buried in retrievable storage pose another problem. Retrieval systems must be developed to reduce worker exposure and secondary waste quantities. Another high-priority need is in situ methods for containment and treatment.

Radioactive Tank Waste Remediation - Across the DOE Complex, hundreds of large storage tanks contain hundreds of thousands of cubic meters of high-level mixed waste. Primary areas of concern are deteriorating tank structures and consequent leakage of their contents. Research and technology development activities must focus on the development of safe, reliable, cost-effective methods for characterization, retrieval, treatment, and final disposal of the wastes.

Mixed Waste Characterization, Treatment, and Disposal - DOE faces major technical challenges in the management of low-level radioactive mixed waste. Several conflicting regulations, together with a lack of definitive mixed waste treatment standards hamper mixed waste treatment and disposal. Disposal capacity for mixed waste is also expensive and severely limited. DOE now spends millions of dollars annually to store mixed waste because of the lack of accepted treatment technology and disposal capacity. In addition, currently available waste management practices require extensive, and

hence costly waste characterization before disposal. Therefore, DOE must pursue technology that leads to better and less expensive characterization, retrieval, handling, treatment, and disposal of mixed waste.

Decontamination and Decommissioning - The aging of DOE's weapons facilities, along with the reduction in nuclear weapons production, has resulted in a need to transition, decommission, deactivate, and dispose of numerous facilities contaminated with radionuclides and hazardous materials. While building and scrap materials at the sites are a potential resource, with a significant economic value, current regulations lack clear release standards. This indirectly discourages the recovery, recycling, and/or reuse of these resources. The development of enhanced technologies for the decontamination of these materials, and effective communication of the low relative risks involved, will facilitate the recovery, recycle, and/or reuse of these resources. Improved materials removal, handling, and processing technologies will enhance worker safety and reduce cost.

Materials development work may be performed in any of these five Focus Areas. Focus Area-specific projects are identified as such. Other projects serving more than one Focus Area are supported by one of the three OST Crosscut Programs: the Characterization, Monitoring, and Sensor Program, the Robotics Program and the Efficient Separations and Processing Program. Funding levels are reported for the total project, which includes materials development and demonstration. For most projects, materials development accounts for less than 25 percent of the funds.

OFFICE OF WASTE MANAGEMENT

HIGH LEVEL WASTE DIVISION

The objective of the High Level Waste Division is to conduct waste management activities for ending interim storage of high-level waste and achieving permanent disposal of high-level waste at the Savannah River Site in South Carolina. Additionally, Congress directed the Department in 1980 to demonstrate the solidification of liquid high-level waste at West Valley (New York) which originated at the nation's only commercial plant to reprocess spent nuclear fuel. At both of these sites a program is in place to immobilize the high-level waste in preparation for geologic disposal.

At Savannah River and West Valley, high-level waste will be immobilized in a borosilicate glass prepared in a liquid-fed ceramic joule-heated melter. The Defense Waste Processing Facility at Savannah River is beginning non-radioactive operations in preparation for radioactive operation. West Valley is constructing the vitrification cell. For these two projects, materials research focuses on verifying the product consistency of the waste form based on a reference formulation chosen some time ago.

MATERIALS PREPARATION, SYNTHESIS, DEPOSITION, GROWTH OR FORMING

234. **TECHNICAL SUPPORT TO WEST VALLEY DEMONSTRATION PROJECT**
$1,300,000
DOE Contact: J. J. May, (716) 942-2161
PNNL Contact: M. Elliot, (509) 376-9858

The West Valley Support Project (WVSP) conducted by the Pacific Northwest National Laboratory (PNNL) is designed to meet the technology needs for the West Valley Demonstration Project (WVDP) and provide support to the subsequent site stabilization activities. The current objectives of the WVDP, as understood by PNNL, are: (1) to complete nonradioactive process testing, operational readiness reviews, and radioactive start-up of the vitrification facility; (2) to maintain safe storage of liquid high-level waste at the West Valley site; (3) to maintain a knowledgeable core of process support personnel to resolve current and future technical issues; (4) to resolve issues related to the site Environmental Impact Statement and other documents; and (5) to proceed with development of site stabilization activities particularly in the area of tank heel removal.

Keywords: Process Control, Storage, Technology

235. **CERAMIC FINAL FORMS**
$300,000
DOE Contact: Ronald D. Streit, (510) 422-7045
LLNL Contact: Robert Hoppert, (510) 423-2420

Operations of the Mixed Waste Management Facility (MWMF) will yield ash-like residues (oxides, nitrates, etc. containing RCRA metals and radioactive elements) from the organic components of low-level mixed waste. These residues will be stabilized as a durable and leach-resistant ceramic waste form produced by traditional high-temperature powder technologies. Formulations for various input waste streams are being optimized.

Keywords Ceramic, Final Waste Form, Ash

236. **MICROENCAPSULATION IN FINAL FORMS**
$67,000
DOE Contact: Ronald D. Streit, (510) 422-7045
LLNL Contact: Robert Hoppert, (510) 423-2420

Operations of the Mixed Waste Management Facility (MWMF) will yield salt residues from the destruction of organic components of low-level mixed waste. Salts will be cleaned to the extent possible for "direct" disposal. Salts containing RCRA metals and radioactive elements after processing will be stabilized by microencapsulation in polyethylene or in a thermosetting polymer. Volatile inorganic solids will be microencapsulated in sulfur polymer cement. Pending funding availability, these technologies are being optimized for MWMF operations.

Keywords Final Waste Form, Encapsulation, Polymer

237. **FINAL WASTE FORM PROGRAM**
$4,000,000
DOE Contact: Michael Torbert, (301) 903-7109

In support of the Oak Ridge Reservation (ORR) LDR Federal Facility Compliance Agreement as well as the Federal Facility Compliance Act, a program is underway to demonstrate, at the bench-scale level, applicable final waste forms for sludges, soils, other treatment residues, and secondary wastes. The primary focus of this activity is to demonstrate appropriate grout waste forms, glass waste forms, and thermoplastic waste forms. This work is being done on actual ORR wastes and supports the LDR FFCA. It will provide technology support to ORR privatization activities. This activity will support a joint CRADA with Savannah River Technical Center and SEG.

Keywords Final Waste Form, Grout, Glass, Thermoplastic, Bench-Scale

MATERIALS PROPERTIES, BEHAVIOR, CHARACTERIZATION OR TESTING

238. **MATERIALS CHARACTERIZATION CENTER TESTING OF WEST VALLEY FORMULATION GLASS**
$396,600
DOE Contact: J. J. May, (716) 942-2161
PNNL Contact: G. L. Smith, (509) 372-1957

Materials Characterization Center (MCC) is evaluating the chemical durability of glasses whose compositions are within the expected range of composition of the West Valley Demonstration Project borosilicate glass waste form. These include nonradioactive glass containing surrogate elements for radionuclides and radioactive glass doped with appropriate radionuclides. The MCC also is testing of a small sample of glass containing actual West Valley high-level waste.

Keywords Radioactive Waste Host

239. **ARGONNE NATIONAL LABORATORY HIGH-LEVEL WASTE BOROSILICATE GLASS TESTING PROGRAM**
$1,500,000
DOE Contact K. Picha, (301) 903-7199

Argonne National Laboratory (ANL) is continuing a series of tests of high-level waste borosilicate glass. These tests, which have been supported by the Office of Environmental Management since FY 1989, will provide a better understanding of the long-term borosilicate glass corrosion mechanisms and durability concerns. Included in these tests are: Defense Waste Processing Facility (DWPF)-based glass drip tests, DWPF sludge-based glass performance tests, long term drip testing on actinide-doped ATM-10 glass, and continued performance testing of West Valley Demonstration Project reference 6 glass.

Keywords Waste, Waste Form, Borosilicate Glass, Waste Acceptance Specifications

OFFICE OF SCIENCE AND TECHNOLOGY

The Office of Science and Technology (OST) is responsible for managing and directing targeted basic research and focused, solution-oriented technology development programs to support the DOE Office of Environmental Management (EM). Programs involve research, development, demonstration, testing and evaluation activities that are designed to produce innovative technologies and technology systems to meet national needs for regulatory compliance, lower life-cycle costs, and reduced risks to the environment.

Certain areas of OST's Technology Development Program focus on materials research in order to provide better, faster, safer and more cost-effective approaches to identify, characterize and clean up DOE's waste problem. The Technology Development Program is investigating various types of cement and polymer technologies for stabilization and containment of wastes. The applicability of these substances is being demonstrated, tested, and evaluated for implementation at specific sites. Technology development and demonstrations into glasses and ceramics are being pursued to better understand high-temperature technologies, useful for containment of contaminated soils. Vitrification and plasma technologies are being developed for treating specific mixed waste streams. OST will continue to fund these materials research projects, as well as others, to provide the basis for other applied research in the Technology Development Program.

MATERIALS PREPARATION, SYNTHESIS, DEPOSITION, GROWTH, OR FORMING

240. **POLYMER ENCAPSULATION**
$1,764,000
DOE Field Office Contact: Julie Conner, (208) 526-0648
DOE HQ Program Manager: Alison Johnson, (301) 903-7923 and Grace Ordaz, (301) 903-7440
EG&G Rocky Flats Contact: Andrea Faucette, (303) 966-6420
EM Focus Area: Mixed Waste

Polymer encapsulation of mixed wastes encloses waste products in thermoplastic materials using commercially available processing technologies. The configuration under development at the Rocky Flats Environmental Technology Site uses a twin-screw extruder to microencapsulate waste. The process aims at meeting applicable disposal site, EPA, and DOT acceptance criteria for various wastes. Microencapsulation involves combining thermoplastic polymers (i.e. polyethylene) with dried waste; melting, mixing, and extruding the combination in a commercially-available extruder; and allowing the molten plastic to cool and solidify. Hazardous constituents are immobilized in the plastic matrix. Nitrate salts, bypass sludge, incinerator ash, and secondary wastes are the target streams. Microencapsulation tests of a variety of waste streams have been performed with the extruded waste forms meeting TCLP leach test performance limits.

Keywords: Alternative Final Waste Form, Polymer Encapsulation, Hydroxide Sludge, Polyethylene

241. **MICROWAVE SOLIDIFICATION**
$1,300,000
DOE Field Office Contact: Julie Conner, (208) 526-0648
DOE HQ Program Manager: Alison Johnson, (301) 903-7923 and Grace Ordaz, (301) 903-7440
EG&G Rocky Flats Contact: Greg Sprenger, (303) 966-3159
EM Focus Area: Mixed Waste

The microwave solidification project is developing a method to immobilize wastes for compliance with EPA disposal regulations and to minimize volume of wastes for storage and disposal. Microwave solidification uses 915 MHZ microwave energy to vitrify waste solids. Dried waste and glass formers are fed into drums and melt "in the drum" from applied microwave heating. This technology is being evaluated as a potential method to treat several mixed wastes, including process sludges, incinerator ash, and miscellaneous wastes, such as crucibles and foundry materials.

Keywords: Alternative Final Waste Form, Microwave Solidification, Vitrification, In Drum Melting

242. **FIXED HEARTH PLASMA TREATMENT PROCESS**
$3,455,000
DOE Field Office Contact: Julie Conner, (208) 526-0648
DOE HQ Program Manager: Alison Johnson, (301) 903-7923 and Grace Ordaz, (301) 903-7440
EG&G Idaho Contact: Ray Geimer, (208) 528-2144
EM Focus Area: Mixed Waste

This technology, the Plasma Hearth Process (PHP), converts entire drums of low-level mixed waste (LLMW) directly into an enhanced waste form without extensive pretreatment or characterization. Organics are destroyed while metals and inorganics are melted, creating a vitrified slag and molten metal. The process is characterized by high-efficiency destruction of organics, encapsulation of heavy metals and radionuclides in the vitrified final waste form, large volume reduction of waste to be disposed, possible recycling of metals, low off-gas flow rates, and the capability of processing many waste types in a single-step process. The non-radioactive proof-of-principle concept demonstration has been completed. The remaining work in this task focuses on design, fabrication, and demonstration of a near full-scale pilot system for non-radioactive operation.

Keywords: Plasma, Final Form, Low-Level Mixed Waste, Pilot-Scale

243. **FIXED HEARTH PLASMA RADIOACTIVE WASTE TEST**
$2,623,000
DOE Field Office Contact: Julie Conner, (208)-526-0648
DOE HQ Program Manager: Alison Johnson, (301) 903-7923 and Grace Ordaz, (301) 903-7440
ANL-W Field Contact: Carla Dwight, (208) 533-7651
EM Focus Area: Mixed Waste

This project involves the design and construction of the facility modifications to house the bench-scale Plasma Hearth Process to be tested in the Plasma Hearth Process Radioactive Waste Test - Idaho. It also includes tasks to develop the mechanisms by which actual waste can be repackaged for testing in the bench-scale system, the radioactive waste forms produced by the process can be sampled and analyzed, and the pertinent analysis to be made to ensure safe operation of the plasma system in the

ANL-W TREAT facility. Waste operations and sampling and analysis during the bench-scale demonstration are covered in the task.

Keywords: Plasma, Final Form, Low-Level Mixed Waste, Bench-Scale

244. **PHOSPHATE-BONDED CERAMIC WASTE FORMS**
(Carryover funds)
DOE Field Office Contact: Julie Conner, (208) 526-0648
DOE HQ Program Manager: Alison Johnson, (301) 903-7923 and Grace Ordaz, (301) 903-7440
ANLC Contact: Arun Wagh, (708) 252-4295
EM Focus Area: Mixed Waste

Chemically-bonded ceramics (CBCs) are being investigated as an alternative final waste form for streams that cannot be handled by other established methods. Phosphate bonded ceramics are a subclass of CBCs and have several advantages over other systems for stabilization and encapsulation of LLMW. These include insolubility in water, high-temperature stability, and the ability to cure at room temperatures. Studies are underway to stabilize waste streams containing liquid mercury, mercury-contaminated aqueous liquids, toxic and heavy metal containing materials, salt cakes, beryllium wastes, and pyrophorics by encapsulating them in phosphate-bonded ceramics. (Effort was conducted during FY95 using carryover funds.)

Keywords: Alternate Final Waste Form, Ceramics, Phosphate

245. **HIGH TEMPERATURE DEMONSTRATIONS ON ACTUAL MIXED WASTE**
$909,000
DOE Field Office Contact: Julie Conner, (208) 526-0648
DOE HQ Program Manager: Alison Johnson, (301) 903-7923 and Grace Ordaz, (301) 903-7440
Savannah River Contact: Ray Schumacher, (803) 725-3803
EM Focus Area: Mixed Waste

This project investigated innovative methods of vitrification that provide higher temperature processing capabilities. High temperature processing is desirable where there are insufficient fluxing agents available within the wastes. Higher temperatures however, can also increase volatilization, which is undesirable. Methods of vitrification under consideration include induction, plasma, and high temperature joule heating.

Keywords: Vitrification, High Temperature

246. **PLASMA TESTING & SUPPORT**
$2,160,000
DOE Field Office Contact: Gary Staats (412) 892-6741
DOE HQ Program Manager: Alison Johnson, (301) 903-7923 and Grace Ordaz, (301) 903-7440
MSE Contact: Jeff Ruffner (406) 494-7412
EM Focus Area: Mixed Waste

This project included the testing of several high-metals content feeds in the Plasma Centrifugal Furnace and general engineering/technical support in high temperature processing areas for a future Minimum Additive Waste Stabilization (MAWS) demonstration. A small-scale plasma unit was purchased for expedited testing on a variety of wastes in support of slag waste form compositional envelope development. This was required before full-scale testing in the larger PACT 6 plasma unit.

Keywords: Plasma, Centrifugal Furnace, MAWS

247. **STAINLESS STEEL BENEFICIAL REUSE**
$1,931,000
DOE Field Office Program Manager: Paul Hart, (304) 285-4358
DOE HQ Program Manager: Jerry M. Hyde, (301) 903-7914
WSRC, SRS Principle Investigator: Bill Boettinger, (803) 725-4833
EM Focus Area: Decontamination & Decommissioning

The Stainless Steel Beneficial Reuse project involves participation of private industry to melt 304 stainless steel radioactive scrap metal (RMS), and then to fabricate the recycled metal into storage containers. The containers will include 100 cubic foot boxes, 55 gallon drums, 85 gallon overpacks, and other specialized items. The metal to be recycled primarily resides at the Savannah River Site (SRS), but it is the intent to include other sites' RMS in the future. The SRS metals originate from process water heat exchanger components, primary piping, handling equipment, and duct work. All metals selected will meet the Department of Transportation requirement of low-specific activity (LSA) for transportation to the selected subcontractors. Two subcontractors, Manufacturing Sciences Corporation and Carolina Metals, Inc., have participated in a

full scale demonstration in and delivered the first complete products, 100 cubic foot boxes, in August. The SRS has already implemented the boxes for temporary storage of waste.

Keywords: Stainless Steel, Recycle, Storage, Containers

248. **RECYCLE OF DEPLETED URANIUM STUDIES**
$400,000
DOE Field Office Program Manager: Paul Hart, (304) 285-4358
DOE HQ Program Manager: Carl R. Cooley, (301) 903-7276
INEL Principle Investigator: W. J. Quapp, (208) 526-9443
EM Focus Area: Decontamination & Decommissioning

The primary objective of this project is to perform an initial assessment of the feasibility and economic incentives of alternative management options for storing, recycling, and/or disposing of the large depleted uranium (DU) reserves within the DOE Complex. As an alternative to disposal, a concept for converting depleted uranium into concrete shielding material has been developed. Laboratory work continues to improve pellet densities, and preparation for fabrication of depleted uranium DUROCK samples using UO_3 from SRS was initiated, and leach testing of DUCRETE samples was also initiated.

Keywords: Depleted Uranium, DUROCK, DUCRETE, Shielding

249. **DEMONSTRATE CONTAMINATED METAL RECYCLE INTEGRATION AND OPTIMIZATION**
$649,000
DOE Field Program Manager: Paul Hart, (304) 285-4358
DOE HQ Program Manager: Jerry Hyde, (301) 903-7914
DOE Field Project Manager: Melvin Shupe, (406) 494-7205
MSE/PETC Principle Investigator: Bob Balhiser, (406) 494-7282
EM Focus Area: Decontamination & Decommissioning

The objective of this project is to prove the technical and economic feasibility of building and operating a regional radioactive scrap steel (RSS) recycling facility in the western United States. This includes the development of a facility conceptual design based on state-of-the-art commercial steelmaking processes. Activities during FY95 include selecting and collaborating with an industrial team partner to assist MSE in evaluating the feasibility of such a facility. Anticipated activities for FY 1996 include completing a conceptual design of the facility, evaluating alternative sites and developing recommendations, and completing the analysis of regional RSS availability.

Keywords: Radioactive Scrap Steel, Regional Recycling Facility

250. **METAL RECYCLE TECHNOLOGY DEVELOPMENT**
$299,000
DOE Field Program Manager: Paul Hart, (304) 285-4358
DOE HQ Program Manager: Jerry Hyde, (301) 903-7914
ORNL Principle Investigator: H. Wayne Hayden, (615) 574-6936
EM Focus Area: Decontamination & Decommissioning

The objective of this project is the development of effective technologies for the decontamination, recycle, and reuse of radiologically contaminated scrap metal (RSM) from various sites in the DOE complex and the stimulation of the expansion of a commercial RSM recycle industry for processing such scrap. This task evaluates the use of existing DOE equipment and development of improved recycling technologies for RSM. Activities include a contract to Bliss-Salem, Inc. to evaluate the rolling of products from RSM, a proposed CRADA with SEG, Inc. to increase the effectiveness of removal of radiological contaminants and development of prerelease technologies that would result in the product form that could be released for wide use, and the testing of a technology for the removal of radiological contaminants for nickel scrap.

Keywords: Radiological Scrap Metal, Nickel, Recycle

251. **SURFACE ACOUSTIC WAVE ARRAY DETECTORS**
$230,000
DOE Field Contact: Roger Christensen, (509) 372-4606
DOE HQ PM: Caroline Purdy (301) 903-7672
PNNL Contact: Jay W. Grate (509) 375-4547
EM Crosscut Program Characterization, Monitoring, and Sensor Technology

The purpose of this task is to design, develop and demonstrate array sensor systems for sensing volatile organic compounds (VOCs), including chlorinated hydrocarbons and other vapors of interest with regard to environmental cleanup and occupational safety. These sensor arrays will be based on polymer-coated surface acoustic wave (SAW) vapor sensors and data processing using pattern recognition and chemometric techniques. The advantages of the SAW vapor sensor technology

include the rugged planar design of the devices; the suitability of polymer-coated devices for use in arrays with pattern recognition; the fast response times (seconds); rapidly reversible responses-the selective material is not altered by the vapor; the high vapor sensitivities (ppm to ppb detection limits depending on the particular vapor); and the flexibility of the array approach to be adapted to many detection problems. The analyte or analytes to be detected can be changed merely by the selection of the polymer coating and the pattern recognition algorithm used. The combination of the information from the sensor array with modern chemometric data processing techniques creates an intelligent sensor system. The sensor array approach provides greatly increased selectivity and reliability in field environments over a single sensor. Single sensors cannot determine if an interfering species is present that might invalidate the measurement. SAW sensors are more sensitive than other microsensors such as fiber optic devices.

Keywords: Array Sensor, Volatile Organic Compounds, Surface Acoustic Wave

252. **VERSATILE, ROBUST, MINIATURE SIZED AND REAL-TIME RADIATION DETECTOR**
$350,000
DOE Field Contact: Steve Webster (708) 252-2822
DOE HQ PM: Caroline Purdy (301) 903-7672
BNL Contact: Eng-Kie Souw (516) 282-5407
EM Crosscut Program Characterization, Monitoring, and
Sensor Technology

The objective for this project is to develop a miniature, real-time solid-state sensor capable of detecting alpha particles, beta particles and gamma rays. The project has applicability for rapidly scanning surface soils, waste processing streams and facility walls, floors and equipment for decontamination and decommissioning. Although diamond is an ideal detector due to its physical hardness and chemical inertness, its low stopping power makes it suitable for detecting alphas, low energy betas and x-rays. For higher energy betas and gamma rays, stacked layers of cadmium telluride will be developed for the detector. For FY95 the objective is to design, develop and test carbon vapor deposited (CVD) diamond films for use on p-type intrinsic metal diamond nuclear detectors. The project is joint with Northrup-Grumman Corp. and the New Jersey Institute of Technology.

Keywords: Sensor, Alpha Particles, Beta Particles, Gamma Rays

MATERIALS PROPERTIES, BEHAVIOR, CHARACTERIZATION OR TESTING

253. **VITRIFY TO DELIST TO DISPOSE**
$736,000
DOE Field Office Contact: Julie Conner, (208) 526-0648
DOE HQ Program Manager: Alison Johnson, (301) 903-7923 and Grace Ordaz, (301) 903-7440
Savannah River Site Contact: Denny Bickford, (803) 725-3737
EM Focus Area: Mixed Waste

Vitrification involves converting wastes, which are primarily inorganic in nature, into a durable, leach-resistant glass. Emphasis has been placed on broadening the number of waste streams applicable to vitrification by establishing the processing envelopes for specific representative waste streams. Surrogates of radioactive waste streams have been vitrified in pilot-scale demonstrations conducted at Clemson University in FY95. In addition, a pilot-scale radioactive demonstration on actual Savannah River Site M-area sludge was conducted at Catholic University. A major effort was initiated in FY95 to identify an actual mixed waste stream and procure the equipment to assemble a transportable field-scale vitrification unit. The waste stream, Oak Ridge WETF (an inorganic wastewater treatment residue) sludge, was successfully vitrified at the bench-scale at Oak Ridge. A field-scale radioactive demonstration using the transportable vitrification system is underway at the Oak Ridge K-25 Site.

Keywords: Vitrification, Low-Level Mixed Waste, Joule Heated Glass Melter

254. **VITRIFICATION OF ROCKY FLATS WASTE**
$309,000
DOE Field Office Contact: Julie Conner, (208) 526-0648
DOE HQ Program Manager: Alison Johnson, (301) 903-7923 and Grace Ordaz, (301) 903-7440
PNNL Contact: Richard Peters (509) 376-3903
EM Focus Area: Mixed Waste

This project determined the vitrification process envelope for three actual waste streams. The process envelopes were defined in terms of waste stream compositional variability, glass forming additives, and the limits of incorporation of troublesome species. The process

envelopes were determined by a combination of crucible tests, pilot-scale melter runs and vitrification processing modeling. Leaching tests show that the mixed waste glasses are generally as durable or more durable than high-level waste glasses.

Keywords: Vitrification, Low-Level Mixed Waste, Joule Heated Glass Melter

255. **PLASMA HEARTH PROCESS RADIOACTIVE WASTE TEST - IDAHO**
$1,350,000
DOE Field Office Contact: Julie Conner, (208) 526-0648
DOE HQ Program Manager: Alison Johnson, (301) 903-7923 and Grace Ordaz, (301) 903-7440
EG&G Idaho Contact: Bob Gillans, (208) 528-2114
EM Focus Area: Mixed Waste

This project involved the design, construction, testing, and evaluation of a bench-scale Plasma Hearth Process (PHP). The primary goal of this work was to assess the performance of the PHP on actual radioactive wastes and to determine the fate of the radionuclides contaminating the waste upon treatment. The successful conclusion of this project will ensure that the PHP can be employed in radioactive service. In addition data collected in this work will improve the simulation of radionuclides in pilot-scale systems by surrogates.

Keywords: Plasma, Final Form, Low-Level Mixed Waste, Bench-Scale

256. **VITREOUS CERAMIC COMPOSITIONAL ENVELOPE STUDY**
$200,000
DOE Field Contact: James Brown (803) 725-2760
DOE HQ PM: Skip Chamberlain (301) 903-7248
ANL Contact: Dave Wronkiewicz (708) 252-7263
EM Focus Area: Landfill Stabilization

The objective of this program is to utilize tailored slag waste forms to expand the range of waste streams that can be treated using the MAWS approach. Compositional ranges appropriate to the production of tailored slag waste forms will be identified for these waste streams. These studies will complement the composition envelopes being studied for glass waste forms.

Keywords: Composition, Characterization, MAWS

257. **GRAPHITE DC PLASMA ARC MELTER**
$1,242,000
DOE Field Contact: James Brown (803) 725-2760
DOE HQ PM: Skip Chamberlain (301) 903-7248
LIMIT Contact: Jeff Surma (509) 376-4905
EM Focus Area: Landfill Stabilization

The objective of this program is to demonstrate the applicability of the Graphite DC Plasma Arc Melter for treating mixed wastes and contaminated soils and for providing an extremely durable waste form for disposal. An engineering scale, radioactive capable furnace system was to be installed and tested at PNNL. This furnace includes analytical instruments for making spatially resolved measurements of furnace and glass temperatures and for the on-line measurements of exhaust emissions, both in the furnace chamber and the off-gas. The capacity of the system will be optimized through the use of process diagnostics.

Keywords: Graphite, DC, Plasma, Arc, Melter

258. **VITREOUS CERAMIC FORMULATION**
$200,000
DOE Field Contact: James Brown (803) 725-2760
DOE HQ PM: Skip Chamberlain (301) 903-7248
LIMIT Contact: Xiangdong Feng (509) 373-7284
EM Focus Area: Landfill Stabilization

The object of this program is to use vitreous ceramic waste forms to expand the range of waste streams that can be treated and to develop vitreous ceramics into desirable final waste forms for treating low-level waste and mixed waste. The work is aimed at those waste streams not amenable to producing glass waste forms with high waste loading. The compositional envelopes will serve as guides for remediation of a wider variety of waste streams and reduction of overall disposal costs.

Keywords: Ceramics, Vitrification, Waste forms

259. **HOT CELL STUDIES**
$400,000
DOE Field Office Contact: J. O. Moore, (423) 576-3536
DOE HQ Program Manager: Dave Geiser, (301) 903-7688
ORNL Contact: Rodney Hunt, (505) 667-0088
EM Focus Area: Radioactive Tank Waste Remediation

The U.S. Department of Energy is faced with safely treating and disposing millions of gallons of Liquid Radioactive

Waste stored in High Level Waste tanks across the United States. Only a small amount of radioactive material contributes to the millions of gallons of High Level waste. By removing the radioactive components from the waste, a large volume reduction of waste to be solidified is achieved. A separations program has been established to accomplish this task. Various sorbents are being developed and tested to evaluate their effectiveness to remove cesium (Cs) from these waste streams. The removal (concentration) of cesium is important to reduce the volume of High Level Waste processed for glass formulation.

Keywords: Separations, Cesium, Hot Cells, High Level Waste

260. **CESIUM REMOVAL DEMONSTRATION**
$700,000
DOE Field Office Contact: J. O. Moore, (423) 576-3536
DOE HQ Program Manager: Dave Geiser, (301) 903-7688
ORNL Contact: Rodney Hunt, (505) 667-0088
EM Focus Area: Radioactive Tank Waste Remediation

The U.S. Department of Energy is faced with safely treating and disposing millions of gallons of Liquid Radioactive Waste stored in High Level Waste tanks across the United States. Only a small amount of radioactive material contributes to the millions of gallons of High Level waste. By removing the radioactive components from the waste, a large volume reduction of waste to be solidified is achieved. A separations program has been established to accomplish this task. Various sorbents are being developed and tested to evaluate their effectiveness to remove cesium (Cs) from these waste streams. This project chooses sorbents studied in the ORNL hot cell tests to treat 25,000 gallons of Melton Valley Storage Tank Waste at ORNL. The removal (concentration) of cesium is important to reduce the volume of High Level Waste processed for glass formulation.

Keywords: Separations, Cesium, High Level Waste

261. **Tc AND Ni REMOVAL USING ION EXCHANGE**
$546,000
DOE Field Office Contact: Dennis Alona, (505) 845-4296
DOE HQ Program Manager Kurt Gerdes, (301) 903-7289
LANL Contact: Moses Attrep, (505) 667-0088
EM Crosscut Program: Efficient Separations and Processing

The U.S. Department of Energy is faced with safely treating and disposing millions of gallons of Liquid Radioactive Waste stored in High Level Waste tanks across the United States. Only a small amount of radioactive material contributes to the millions of gallons of High Level waste. By removing the radioactive components from the waste, a large volume reduction of waste to be solidified is achieved. A separations program has been established to accomplish this task. Anion exchangers are being developed and tested to evaluate their effectiveness to remove Technetium (Tc) and Nickel (Ni) from these waste streams. Removal of these materials is important for efficient processing of High Level Waste into glass.

Keywords: Anion, Separations, High Level Waste

262. **CRYSTALLINE SILICOTITANATE FOR Cs/Sr REMOVAL**
$873,000
DOE Field Office Contact: Dennis Alona, (505) 845-4296
DOE HQ Program Manager: Kurt Gerdes, (301) 903-7289
LANL Contact: Norman Brown, (505) 845-8180
EM Crosscut Program: Efficient Separations and Processing

The U.S. Department of Energy is faced with safely treating and disposing millions of gallons of Liquid Radioactive Waste stored in High Level Waste tanks across the United States. Only a small amount of radioactive material contributes to the millions of gallons of High Level waste. By removing the radioactive components from the waste, a large volume reduction of waste to be solidified is achieved. A separations program has been established to accomplish this task. Ion exchange resins are being developed and tested to evaluate their effectiveness to remove Cesium (Cs) and Strontium (Sr) from these waste streams. Removal of these materials is important for efficient processing of High Level Waste into glass. Hot cell studies are being performed for this material with anticipation of performing pilot scale processing.

Keywords: Ion Exchange, Separations, High Level Waste

263. **TUCS/PHOSPHATE IMMOBILIZATION OF ACTINIDES**
$300,000
DOE Field Office Contact: S Webster, (708) 252-3653
DOE HQ Program Manager:
Kurt Gerdes, (301) 903-7289
Argonne Contact: K. Nash, (708) 252-3581
EM Crosscut Program: Efficient Separations and Processing

The U.S. Department of Energy facilities face the challenge of restoring facilities following years of radioactive materials processing. Various DOE sites have contaminated soil that needs remediation. The Thermally Unstable Complexants (TUCS) technology (used to sequester and immobilize actinides in soil by phosphate mineralization), is being developed and evaluated. This process will enhance DOE's ability to restore sites contaminated with radioactive constituents.

Keywords: Plumes, Soil, Immobilization, Restoration